

What Is Claimed Is:

Sub H<sup>2</sup>

1. A composition comprising:
  - (a) a cyanoacrylate component,
  - (b) a metallocene component, and
  - (c) a photoinitiator component.

2. The composition according to Claim 1, which includes a polymerizingly effective amount of the photoinitiator component to render it capable of photocuring upon exposure to electromagnetic radiation.

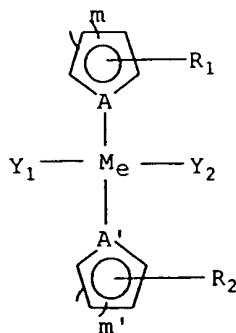
3. The composition according to Claim 1, wherein the cyanoacrylate component includes a cyanoacrylate monomer represented by  $H_2C=C(CN)-COOR$ , wherein R is selected from the group consisting of  $C_{1-15}$  alkyl, alkoxyalkyl, cycloalkyl, alkenyl, aralkyl, aryl, allyl and haloalkyl groups.

Sub H<sup>1</sup>

4. The composition according to Claim 1, wherein the cyanoacrylate monomer is selected from the group consisting of methyl cyanoacrylate, ethyl-2-cyanoacrylate, propyl cyanoacrylates, butyl cyanoacrylates, octyl cyanoacrylates, allyl-2-cyanoacrylate,  $\beta$ -methoxyethyl-2-cyanoacrylate and combinations thereof.

5. The composition according to Claim 1, wherein the cyanoacrylate monomer is ethyl-2-cyanoacrylate.

6. The composition according to Claim 1, wherein the metallocene component includes materials within the following structure:



wherein  $R_1$  and  $R_2$  may occur at least once on each ring, may be the same or different and may be selected from H; any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms; acetyl; vinyl; allyl; hydroxyl; carboxyl;  $-(CH_2)_n-OH$ , wherein  $n$  may be an integer in the range of 1 to about 8;  $-(CH_2)_n-COOR_3$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $R_3$  may be H; Li; Na; any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms;  $-(CH_2)_{n'}$ , wherein  $n'$  may be an integer in the range of 2 to about 8;  $-(CH_2)_n-OR_4$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $R_4$  may be any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms; and  $-(CH_2)_n-N^+(CH_3)_3$ ,  $X^-$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $X$  may be selected from  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $ClO_4^-$  and  $BF_4^-$ ;

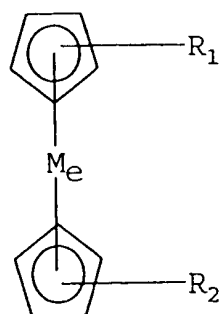
$Y_1$  and  $Y_2$  may or may not be present, but when present at least once may be the same or different and may be selected from H,  $Cl^-$ ,  $Br^-$ ,  $I^-$ , cyano, methoxy, acetyl, hydroxy, nitro, trialkylamines, triarylamines, trialkylphosphines, triphenylamine, and tosyl;

$A$  and  $A'$  may be the same or different and may be C or N;

$m$  and  $m'$  may be the same or different and may be 1 or 2; and

$M_2$  is selected from Fe, Ti, Ru, Co, Ni, Cr, Cu, Mn, Pd, Ag, Rh, Pt, Zr, Hf, Nb, V and Mo.

7. The composition according to Claim 1, wherein the metallocene component includes materials within the following structure:



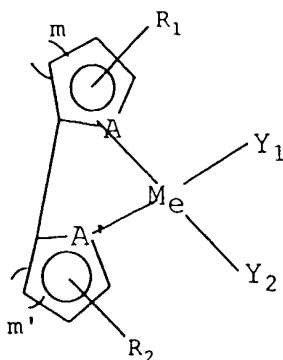
wherein  $R_1$  and  $R_2$  may be the same or different, and each is a member selected from the group consisting of H; any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms, acetyl; vinyl; allyl; hydroxyl; carboxyl;  $-(CH_2)_n-OH$ , wherein  $n$  may be an integer in the range of 1 to about 8;  $-(CH_2)_n-COOR_3$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $R_3$  may be any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms, H, Li, Na, or  $-(CH_2)_{n'}$ , wherein  $n'$  may be an integer in the range of 2 to about 8;  $-(CH_2)_n-OR_4$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $R_4$  may be any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms; and  $-(CH_2)_n-N^+(CH_3)_3 X^-$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $X$  is a member selected from the group consisting of  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $ClO_4^-$  and  $BF_4^-$ ; and

$M_e$  is selected from the group consisting of Fe, Ti, Ru, Co, Ni, Cr, Zr, Hf, Nb, V and Mo.

8. The composition according to Claim 6, wherein  $M_e$  is selected from the group consisting of Ti, Cr, Cu, Mn, Ag, Zr, Hf and Mo.

9. The composition according to Claim 1, wherein the metallocene component includes materials within the

following structure:



wherein  $R_1$  and  $R_2$  may occur at least once on each ring, may be the same or different and may be selected from H; any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms; acetyl; vinyl; allyl; hydroxyl; carboxyl;  $-(CH_2)_n-OH$ , wherein  $n$  may be an integer in the range of 1 to about 8;  $-(CH_2)_n-COOR_3$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $R_3$  may be H; Li; Na; any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms;  $-(CH_2)_{n'}$ , wherein  $n'$  may be an integer in the range of 2 to about 8;  $-(CH_2)_n-OR_4$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $R_4$  may be any straight- or branched-chain alkyl constituent having from 1 to about 8 carbon atoms; and  $-(CH_2)_n-N^+(CH_3)_3 X^-$ , wherein  $n$  may be an integer in the range of 1 to about 8 and  $X$  may be selected from  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $ClO_4^-$  and  $BF_4^-$ ;

$Y_1$  and  $Y_2$  may or may not be present, but when present at least once may be the same or different and may be selected from H,  $Cl^-$ ,  $Br^-$ ,  $I^-$ , cyano, methoxy, acetyl, hydroxy, nitro, trialkylamines, triarylamines, trialkylphosphines, triphenylamine, and tosyl;

$A$  and  $A'$  may be the same or different and may be C or N;

$m$  and  $m'$  may be the same or different and may be 1 or 2; and

*July 1*  
*part 1*  
M<sub>e</sub> is selected from Fe, Ti, Ru, Co, Ni, Cr, Cu, Mn, Pd, Ag, Rh, Pt, Zr, Hf, Nb, V and Mo.

10. The composition according to Claim 9, wherein R<sub>1</sub> and R<sub>2</sub> are each H; Y<sub>1</sub> and Y<sub>2</sub> are each Cl; A and A' are each N; m and m' are each 2; and Me is Ru.

*Sub A*  
11. The composition according to Claim 1, wherein the metallocene is selected from the group consisting of diaryl phosphino metal-complexed ferrocenes, bis-alkyl ferrocenes, and M<sub>e</sub>[CW<sub>3</sub>-CO-CH=C(O<sup>-</sup>)-CW'<sub>3</sub>]<sub>2</sub>, wherein M<sub>e</sub> is selected from Fe, Ti, Ru, Co, Ni, Cr, Cu, Mn, Pd, Ag, Rh, Pt, Zr, Hf, Nb, V and Mo, and W and W' may be the same or different and may be selected from H and halogen.

*Sub A*  
12. The composition according to Claim 1, wherein the metallocene component is a member selected from the group consisting of ferrocenes, titanocenes, and derivatives and combinations thereof.

*Sub A*  
13. The composition according to Claim 1, wherein the metallocene is ferrocene.

*Sub A 3*  
14. The composition according to Claim 1, wherein the photoinitiator component is selected from the group consisting of 1-hydroxycyclohexyl phenyl ketone, 2-methyl-1-[4-(methylthio)phenyl]-2-morpholino propan-1-one, benzophenone, 2-benzyl-2-N,N-dimethylamino-1-(4-morpholinophenyl)-1-butanone, 2,2-dimethoxy-2-phenyl acetophenone, bis(2,6-dimethoxybenzoyl-2,4,4-trimethyl pentyl) phosphine oxide, 2-hydroxy-2-methyl-1-phenyl-propan-1-one, 2-hydroxy-2-methyl-1-phenyl-1-propane, 2,4,6-trimethylbenzoyldiphenyl-phosphine oxide, bis(2,4,6-trimethyl benzoyl) phenyl phosphine oxide, 2-hydroxy-2-methyl-1-phenyl-propan-1-one, visible light [blue] photoinitiators, dl-camphorquinone, alkyl pyruvates, aryl pyruvates and combinations thereof.

15. The composition according to any one of Claims 1-14, wherein the source of electromagnetic radiation is selected from the group consisting of ultraviolet light, visible light, electron beam, x-rays, infrared radiation and combinations thereof.

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16. The composition according to any one of Claims 1-14, further comprising a member selected from the group consisting of viscosity-modifying agents, rubber toughening agents, thixotropy rendering agents, thermal-stabilizing agents, and combinations thereof.

17. The composition according to any one of Claims 1-14, wherein the composition is useful as an adhesive, a sealant or a coating.

18. A method of polymerizing a photocurable composition, said method comprising the steps of:

- (a) providing an amount of the composition according to any one of Claims 1-14 and 17; and
- (b) subjecting the composition to electromagnetic radiation effective to cure the composition.

19. The composition according to any one of Claims 1-14 and 17 in a one-part formulation.

sub 17  
20. The composition according to Claim 2, wherein the cyanoacrylate component includes ethyl-2-cyanoacrylate which is present in an amount within the range of about 97.9% by weight to about 99.4% by weight of the total composition, the metallocene component is ferrocene which is present in an amount of about 0.1% by weight of the total composition, and the photoinitiator component includes the combination of bis(2,6-dimethoxybenzoyl-2,4-,4-trimethyl) pentyl phosphine oxide and 2-hydroxy-2-methyl-1-phenyl-propan-1-one which is present in

an amount in the range of about 0.5% to about 2% by weight of the total composition.

21. The composition according to Claim 2, wherein the cyanoacrylate component includes: ethyl-2-cyanoacrylate which is present in an amount within the range of about 98.715% to about 98.75% by weight of the total composition and BF<sub>3</sub> in an amount within the range of about 0.04% to about 0.075% by weight of the total composition, the metallocene component is ferrocene which is present in an amount of about 0.02% by weight of the total composition, and the photoinitiator component includes the combination of bis(2,6-dimethoxybenzoyl-2,4,4-trimethyl) pentyl phosphine oxide and 2-hydroxy-2-methyl-1-phenyl-propan-1-one which is present in an amount of about 1.2% by weight of the total composition.

Sub 115  
22. A reaction product formed from the composition according to any one of Claims 1-17 and 19-21 after exposing the composition to electromagnetic radiation effective to cure the composition.

23. An article assembled with a composition according to any one of Claims 1-17, and 19-21, selected from the group consisting of needles, syringes, lancets, hypodermics, injectors, bodily fluid collector sets, cannula/hub assemblies, cannula/tube assemblies, tube sets, intravenous sets, fluid delivery and withdrawal sets, suction tubes, anesthesia masks, face masks, surgical masks, angioplast catheters, balloon catheters, disc drives, magnetic sensors, battery holding cartridges, loud speakers, phase holograms, lenses and jewelry.

24. A method of using a composition according to any one of Claims 1-17 and 19-21, to manufacture an article selected from the group consisting of needles, syringes, lancets, hypodermics, injectors, bodily fluid collector sets, cannula/hub assemblies, cannula/tube assemblies, tube

sets, intravenous sets, fluid delivery and withdrawal sets, suction tubes, anesthesia masks, face masks, surgical masks, angioplast catheters, balloon catheters, disc drives, magnetic sensors, battery holding cartridges, loud speakers, phase holograms, lenses and jewelry.

25. A method of using a composition according to any one of Claims 1-17 and 19-21, to repair an article selected from the group consisting of needles, syringes, lancets, hypodermics, injectors, bodily fluid collector sets, cannula/hub assemblies, cannula/tube assemblies, tube sets, intravenous sets, fluid delivery and withdrawal sets, suction tubes, anesthesia masks, face masks, surgical masks, angioplast catheters, balloon catheters, disc drives, magnetic sensors, battery holding cartridges, loud speakers, phase holograms, lenses and jewelry.

26. A method of using a one-part composition according to Claim 19 in the assembly of an article which ordinarily would be assembled by applying onto a substrate a primer, followed by an adhesive composition.

27. The composition according to Claim 16, 17 or 19, having a viscosity within the range of about 1 to about 15 cps.

28. The composition according to Claim 16, 17 or 19, having a viscosity within the range of about 100 to about 300 cps.

29. The composition according to Claim 16, 17 or 19, having a viscosity within the range of about 600 to about 1000 cps.

30. The composition according to Claim 26, for use in the manufacture of articles using a wicking application.

31. The composition according to Claim 27, for use in the manufacture of articles having molded polymeric parts to be bonded together.

32. The composition according to Claim 28, for use in the manufacture of articles having porous substrates and/or substrates with gaps greater than about 0.5 mils therebetween.

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